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THE STRIPED CUCUMBER BEETLE

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FOOD PLANTS

The striped cucumber beetle feeds upon a great many different kinds of plants, but the plants of chief importance belong to the cultivated cucurbits. Cucumbers and cantaloups seem to be more severely injured than other members of this family. Beans are subject to attack from the beetles and may be injured to a considerable extent. The beetles readily eat the flowers of a great many plants and may be found in season on aster, goldenrod, ragweed, chokeberry, juneberry, cherry, hawthorn, apple, rose and other plants.

NATURE OF THE INJURY

The striped cucumber beetle is our most injurious insect pest of cucumbers, melons and other cucurbits. In the spring, the adults attack the young plants just as they are emerging from the soil and frequently ruin the entire planting by eating the tender plants or gnawing the stems and tender leaves. The beetles do considerable injury to older plants by their feeding upon the tender leaves and by gnawing off portions of the surface of the stems. The blossoms, also, are attacked by the beetles and many are eaten so badly that they fail to produce fruit. The beetles also attack the fruits and disfigure them by eating portions of the rind.

*The writer is indebted to Professor A. J. Olney who had supervision of the planting and care of the plots, for facilitating in many ways the carrying out of these experiments.

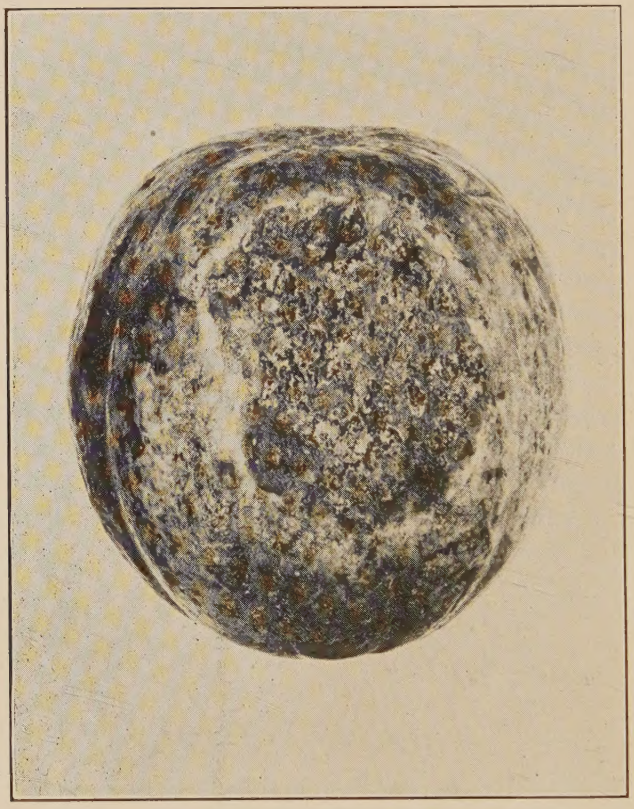

Fig. 1. Cantaloup showing injury by the larvae of the striped cucumber beetle.

The adult also acts as a carrier of the cucurbit wilt organism. The wilt disease may be the cause of very serious loss if it becomes established in a field of melons or other cucurbits.

The larvae or worms injure the older plants by eating into and burrowing into the main root and underground part of the stem. They may also do some injury to the parts of the plant that rest upon the ground. The larvae may bore into the rind of the fruits where they come in contact with the soil. This was the case during the season of 1926, when a good many small to medium sized melons showed this type of injury. The root

and underground stem injury is undoubtedly the cause of the wilting and dying of many vines.

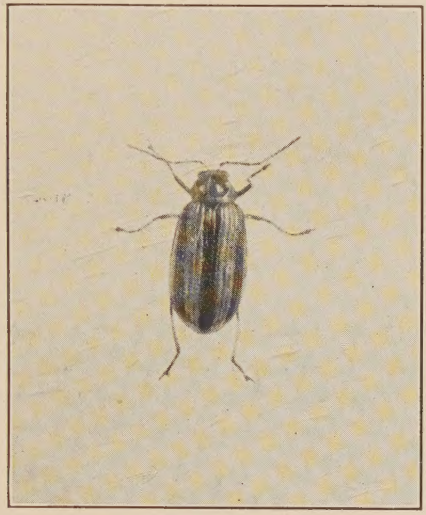

Fig. 2. Adult striped cucumber beetle. Enlarged.

THE DIFFERENT STAGES OF THE BEETLE

Egg. The egg is light yellow to orange colored, depending somewhat upon its age. There is some variation in its size but in general it is about one-fortieth of an inch long and about one-seventieth of an inch thick, or about one-half as wide as it is long. Its surface when viewed under rather high magnification is covered with a sculpturing of hexagonal pits.

Fig. 3. Egg of the striped cucumber beetle. Enlarged.

Larva. The larva is a slender, white, worm-like grub with a dark brown head and anal plate, and a lighter brown thoracic

plate. The newly hatched larva is about one-sixteenth of an inch long and the full-grown larva about three-tenths of an inch long. The larva has three thoracic or true legs and an anal proleg.

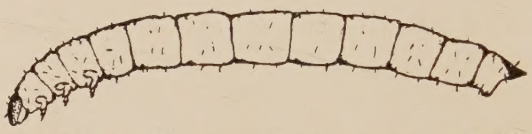

Fig. 4. Larva of the striped cucumber beetle. Elarged

Pupa. The pupa is white or slightly yellowish, nearly the same color as the larva. The pupa is thickest toward the front end and tapering toward the rear. The eyes are large, black and rather prominent. There are some small, bristly hairs on the body and a pair of black spine-like bristles on the posterior end of the body.

Fig. 5. Pupa of the striped cucumber beetle. Enlarged.

Adult. The adult striped cucumber beetle is about one-fifth of an inch long and about one-half as wide. It is yellow above with the head black and black stripes lengthwise on each wing-cover. The under side of the abdomen is black. The antennae are mostly black and the legs yellow with the feet and knees black. In newly transformed adults the color and markings are much lighter.

LIFE HISTORY

The striped cucumber beetle appears in the spring and feeds upon some of its host plants until its more favored food plants are available. Its migration to such plants as cucumbers or

cantaloups takes place in May or early June. This migration generally takes place within a very short time, so that young cucumber or melon seedlings may be destroyed before the presence of the beetle is suspected.

The female beetles place their eggs in the soil about the base of the plants and stems or under clods or in cracks in the soil. The female may produce large numbers of eggs, over 1500 has been reported for a single female. The eggs hatch in one or two weeks, but the period is subject to temperature changes and humidity of environment.

The larval period lasts for two to five or six weeks, depending upon temperature conditions. The larvae may be found in the soil around or boring into the main root or underground portion of the stem or under those parts of the vines and fruits that come in contact with the soil. When the soil is moist or wet, the larvae may be found near the surface or on the soil.

When full-grown, the larva goes down into the soil for an inch or more and constructs a little cell. It then contracts and becomes much thicker and remains in this condition for two to five days, when it pupates. The pupal period ranges from five days to two weeks or longer.

The entire period from egg-laying to the appearance of the adult may be five or six weeks or longer. In the extreme south this period may be a little less than four weeks.

The number of broods varies from one in the more northern states to four as recorded in Texas. From observations made in 1901 at the Kentucky Experiment Station, Professor Garman states that there are not more than two annual broods at this locality and that, under ordinary conditions, probably there is but one. Two broods appeared in 1926 but the limits of the broods were not determined. First brood adults began to appear in numbers on July 20 in the field. These could easily be distinguished by their pale color and faint dark stripes. The first of the second brood adults were collected from cages on September 14. Light colored adults were observed in numbers on

September 6, about the vines. Because of the long life period of the adults there is an overlapping of broods.

The beetles collect on the remnants of cucurbits in the fall and it is likely that most of those that survive the winter have had opportunity for late feeding on cucurbits and have gone into hiding places not far from their last food supply.

CONTROL OF THE CUCUMBER BEETLE

The cucumber beetle has long been recognized as a serious pest of cucurbits, so that a large number of remedies have been suggested for its control. These remedies include both cultural and artificial methods for control. Many of the remedies suggested have been proved to be worthless or of little value. In order to determine which of the more recently recommended insecticides are reliable under conditions in Kentucky, some trials for the control of the beetle were made during the season of 1926.

THE EXPERIMENTS AND METHODS OF PROCEDURE

The experiments were made on the Experiment Farm on plots of one-eightieth acre each. The plots were separated by the omission of one row between plots and there were 32 hills of cucumbers or cantaloups to the plot. The plots were given similar cultural treatments.

The dust insecticides were prepared in a revolving mixer. This was simply a large metal can which was fastened in a revolving rack. To mix the dusts, the machine was revolved with the can lying on its side, then the can was placed so the dust fell from one end of the can to the other. The machine was revolved for about 100 times with the can in each position. All the ingredients of the insecticide were screened before they were mixed.

The dusts were applied with a plunger type of duster when the plants were small and a knapsack duster when the plants were larger. The liquids were applied with a good type of foot pump on a four-foot rod.

The first treatment was given as soon as the plants appeared and treatments were continued until the vines interlocked. The later treatments were given because of the persistent attack of the beetles on both flowers and fruits. Because of the frequency of rains during the season it was difficult to keep the plants protected. The first treatment was made May 28, the last on August 4, there being 14 in all.

FIELD TESTS OF DIFFERENT INSECTICIDES

Calcium Arsenate 1 Pound, Land Plaster 20 Pounds This dust was used on one plot of cantaloups and one plot of cucumbers and was found to give very good protection from the beetles. The dust was a little heavy for use in some of the dusters but it covered the foliage evenly and adhered fairly well to the foliage. The dust was used at the rate of 25 to 70 pounds per acre on the cantaloups and from 20 to 70 pounds per acre on the cucumbers. The plants in general in both plots maintained a vigorous growth thruout the season and there was very little if any burning from the insecticide. The first cantaloup was gathered on August 6, the last on September 14, with the total yield of 405 pounds from the plot. The first of the cucumbers were gathered July 19 and the last on September 13, which was a long season. The total yield was 423 pounds from the plot.

Calcium Arsenate 1 Pound, Hydrated Lime 20 Pounds. This dust was used on one plot of cantaloups and one plot of cucumbers. The dust was used at the rate of 28 to 70 pounds per acre on the cantaloups and at 30 to 70 pounds per acre on the cucumbers. The dust gave very good protection from the beetles, covered the plants very well and was easily applied. The cantaloups in general made good growth during the season, there was no apreciable dwarfing of the plants, but some of the leaves near the center of the hills were injured. The cucumbers appeared to be more sensitive to this dust and while there was very little burning of the foliage, the young plants did not make quite as vigorous growth as where land plaster was used

as a dilutent. The cantaloup plot yielded 365 pounds of cantaloups and the cucumber plot 340 pounds of cucumbers.

Lead Arsenate 1 Pound, Land Plaster 10 Pounds. The lead arsenate-land plaster dust was used on one plot of cantaloups and one plot of cucumbers, at the rate of 25 to 70 pounds on the cantaloups and 20 to 60 pounds on the cucumbers. The plants in both plots in general made very good growth during the season and there was very little beetle injury. No dwarfing or burning of the foliage was observed. The first melons were gathered August 19 and the last on September 14, there being 459 pounds in all from the plot. The first cucumbers were gathered July 19 and the last on September 17 with a total yield of 486 pounds. These were the highest yields of any of the treated plots.

Lead Arsenate 1 Pound, Hydrated Lime 10 Pounds. The lead arsenate and hydrated lime dust was used on one plot of cantaloups and one plot of cucumbers. The dust was used at the rate of 20 to 70 pounds per acre on the cantaloups and on the cucumbers at the rate of 25 to 60 pounds per acre. There was very little injury by the beetles on either plot. There was some foliage injury from the dust on both cucumbers and cantaloups. Some of the leaves were burned but otherwise the vines were apparently uninjured. The young cucumber plants did not start with as vigorous growth as in those plots where either calcium arsenate and hydrated lime dust or lead arsenate and land plaster dust was used. The yield from the cantaloup plot was 398 pounds and from the cucumber plot 377 pounds.

Lead Arsenate 10 Per Cent, Nicotine Sulfate 5 Per Cent, Hydrated Lime 85 Per Cent. This dust was applied to one plot of cantaloups at the rate of 20 to 70 pounds per acre. The dust gave good protection from the beetles. There was some burning of the leaves where the dust accumulated but in general the vines made a good growth. The yield of melons was 330 pounds for the plot, which was considerably less than the higher yields but two and a half times greater than the yield from the check.

Nicotine Dust. The dust used on one plot of cantaloups contained 2 per cent free nicotine, and the applications ranged

from 20 to 65 pounds per acre. The dust failed to give adequate control of the beetles, but it had considerable repelling effect and with estimated kill of 15 per cent of the beetles. The failure of the dust was undoubtedly due in part to weather conditions. A dust made of 90 per cent hydrated lime and 10 per cent nicotine sulfate gave very little better results. The yield from the plot was 206 pounds of melons, which was the lowest yield from any of the melon plots.

Sodium Fluosilicate. Sodium fluosilicate dusts were used on three plots of cantaloups and one plot of cucumbers. The dust for one plot of cantaloups was made of 1 pound of the fluosilicate and 3 pounds of hydrated lime and for one plot 3 pounds of land plaster was substituted for the lime. In these two plots the injury from the dust was severe, the edges of the leaves were burned and curled and the plants themselves dwarfed. After a few dustings, the dust at the 1 to 3 proportions was discontinued.

Sodium fluosilicate at the dilution of 1 pound to 5 of hydrated lime was used on a plot each of cantaloups and cucumbers. This dust gave fair protection from the beetles and a good many dead beetles were found about the vines. There was considerable injury from the dust on both the cantaloups and cucumbers and the cucumber plants were more sensitive to the dust than the cantaloups. The cantaloup plot gave a yield of 255 pounds and the cucumber plot 193 pounds. The yield from the cantaloup plot was next to the lowest for all the treated cantaloup plots and from the cucumber plot the lowest of the treated cucumber plots.

Paradichlorobenzene Dust. A paradichlorobenzene dust was made by dissolving paradichlorobenzene in kerosene oil at the rate of 40 gms in 100 cc and then mixing some of the solution with hydrated lime. A dust was prepared which contained 2 per cent of the paradichlorobenzene. The dust had some repelling effect on the beetles but it was not satisfactory as an insecticide. There was a decided dwarfing of the plants and the yield of cucumbers was only 200 pounds.

Lead Arsenate 2½ Pounds, Calcium Caseinate ½ Pound, Water 50 Gallons. This spray containing lead arsenate with a spreader was used on one plot of cantaloups. The spray gave good protection from the beetles and there was little beetle injury. The vines in general made good growth during the season and there was no apparent spray injury. The yield was 370 pounds, which compares favorably with other sprayed plots.

Calcium Arsenate 1½ Pounds, Hydrated Lime 1½ Pounds, Water 50 Gallons. This plot was an outside plot and on the side on which the beetles first came into the plots. The spray proved effective in protecting the young plants and few of them were badly damaged. A few leaves were burned on the edges where the spray collected in drops, but no permanent injury developed. The plot gave a yield of 402 pounds of cantaloups which was was the largest yield of all the sprayed plots.

Calcium Arsenate 1½ Pounds, Hydrated Lime 1½ Pounds, Bordeaux Mixture 50 Gallons. The spray made of calcium arsenate and Bordeaux mixture gave very good protection from the beetles. This plot was one of the first attacked by the beetles, but very little serious beetle injury occurred. The young plants did not start their growth as vigorously as in some of the other plots but later they made a good apparently healthy growth. The yield from the plot was 381 pounds of melons, which made it rank along with the high producing plots.

Lead Arsenate 1½ Pounds, Bordeaux Mixture 50 Gallons. One plot of cantaloups was sprayed with this mixture and it furnished very good protection from beetle injury. There was no apparent spray injury, such as burning or falling off of leaves but the yield from the plot was not as high as was expected from the general healthy appearance of the vines thruout the season. The yield was 349 pounds as compared with 381 pounds where calcium arsenate was used with Bordeaux mixture.

DISCUSSION OF THE EXPERIMENTS

Nicotine Dust. Nicotine dust containing 2 per cent free nicotine failed to control the beetles and a dust made of 90 per

cent hydrated lime and 10 per cent nicotine sulfate gave very little better results. This was due mostly to weather conditions that prevailed during the greater part of the season of 1926. Nicotine dusts containing 4 to 10 per cent of nicotine sulfate have been used with very good results, but the dust to be effective must be used only on clear, calm days with the temperature not less than 65° F. and preferably 70° F. or higher. The foliage of the plants should also be dry.

Sodium Fluosilicate. Sodium fluosilicate diluted at the rate of 1 pound to 3 pounds of hydrated lime and land plaster proved to be too injurious to the foliage of cantaloups and cucumbers. Young plants and the new growth were burned or dwarfed to such an extent that the use of this mixture was discontinued after a few dustings. The fluosilicate at a dilution of 1 pound to 5 pounds of hydrated lime caused considerable burning of cucumber foliage and the yield from the plot was low.

HIGHEST YIELDS FROM DUST-TREATED PLOTS

Lead arsenate 1 pound and land plaster 10 pounds gave the highest yields of the dust-treated plots for both cantaloups and cucumbers. These yields were 459 pounds for the cantaloup plot and 485 pounds for the cucumber plot. These yields were also the highest for all the treated plots.

Calcium arsenate 1 pound and land plaster 20 pounds gave a yield of 405 pounds for a cantaloup plot and 423 pounds for a cucumber plot. These yields are not greatly different from the higher yields of the lead arsenate-land plaster treated plots.

HYDRATED LIME AND LAND PLASTER AS DILUTENTS

Hydrated lime is very frequently used alone for repelling cucumber beetles and land plaster to a less extent. When hydrated lime and land plaster are mixed with either calcium arsenate or lead arsenate, they make good dust insecticides for controlling the cucumber beetle. The yields were larger from plots of cucumbers and cantaloups which were treated for beetle control with dusts that contained land plaster as a dilutent.

YIELDS FROM SPRAY TREATED PLOTS

One plot of cantaloups which was sprayed with a mixture of calcium arsenate 1½ pounds and 1½ pounds of hydrated lime in 50 gallons of water gave a yield of 402 pounds. This was practically the same yield as where the mixture of calcium arsenate 1 pound and land plaster 20 pounds was used as a dust and was the third highest yield from cantaloup plots.

The second highest yield from spray-treated cantaloups was from a plot that had been sprayed with calcium arsenate 1½ pounds in 50 gallons of Bordeaux mixture. The yield was 381 pounds. A yield of 370 pounds was secured from one plot of cantaloups which had been sprayed with lead arsenate 2½ pounds, calcium caseinate ½ pound in 50 gallons of water.

DUSTS AND SPRAYS

Results from the tests of insecticides made in 1926, showed that some of the dust insecticides gave somewhat higher yields than liquid insecticides; however, some of the sprays gave effective control of the beetles and the yields compared favorably with those from dust-treated plots. The choice between dust and spray may depend to a considerable extent upon the equipment available and the experience of the grower. The dusts can be applied more easily and quickly than the sprays and the apparatus necessary is simpler and generally less expensive. The actual cost of the materials which are necessary for making the sprays is less than that of the dust insecticides but when the saving of time and labor is considered, the dust insecticides are cheaper.

CHECK PLOTS

The plants in the check or untreated plots were all injured and many were cut off or destroyed. By planting an excess of seed, a fair stand was finally established, but the vines lacked the vigor of those in the treated plots, and they began dying much earlier in the season. The yield for the untreated cantaloups was 137 pounds and for the cucumbers 124 pounds.

METEOROLOGICAL NOTES

Spraying operations were hindered during the greater part of the season by an excessive number of showers. The showers in a very great measure reduced the effectiveness of the sprays and made an additional number of applications necessary. The seed in the experimental plots were planted on May 14 when the soil was rather dry. Showers fell on May 14 and May 15 but were not sufficient to give a good germination of the seed. There were showers again on May 30 and May 31. In June, there were 14 days with precipitations of .01 of an inch or more. The total precipitation for the month was 2.78 inches which was less than the normal of 3.99 inches. In July, there were 13 days with precipitations of .01 of an inch or more. The total for the month was 5.95 inches in comparison with 4.44 inches as the normal rainfall. During August, rain fell on 17 days and the total rainfall was 7.03 inches or 3.46 inches in excess of normal.

RECOMMENDATIONS FOR CONTROL

Plant an Excess of Seed. By planting an excess of seed, the attack of the beetles is distributed and the chances for securing a stand of plants is very greatly increased. In localities where the beetles are very destructive, a succession of plantings should be made at about weekly intervals. The seed should be planted as early as is consistent with good practice for the locality.

Stimulate Plant Growth. Applications of manure or fertilizers are necessary to promote a rapid and vigorous growth. Plants that are in a healthy growing condition have a much better chance to withstand beetle attacks than weak plants.

Clean Culture. Damages from the cucumber beetle and other cucurbit insects may be reduced by giving attention to clean culture. After the crop has been gathered, the remnants should be collected and burned, care being taken to destroy as many as possible of the beetles that have collected on the old fruits. Where all the growers in a neighborhood see that the remnants of the cucurbits are destroyed in the fall, the number of beetles will be greatly reduced.

Early Care of Plants. The fields should be examined daily for beetles in the spring. This is necessary because of the sudden appearance of the beetles as a general rule and a great deal of damage may be done before the plants can be protected properly. If there is a crust on the soil when the young plants are emerging, it should be broken up and fine earth should be placed about the stems of the young plants.

The breaking up of the crust is necessary because if it is not done the beetles will crawl down around the young plants and in many instances destroy or injure them.

ARTIFICIAL CONTROL

The grower should procure his insecticides before the time of his actual need of them because they may not be readily obtainable from his local dealer.

Two dust insecticides gave excellent control in tests made in 1926. Lead arsenate 1 pound and land plaster 10 pounds gave somewhat higher yields than calcium arsenate 1 pound and land plaster 20 pounds. Either of these two insecticides may be used, but the second one is considerably cheaper. The plots treated with dust containing hydrated lime as a dilutent did not give as high yields as those where land plaster was used.

Dust, as a rule, is to be preferred because it can be applied more easily and quickly and with simple or less expensive apparatus. The first application should be given as the plants are emerging thru the soil and other applications as needed. When the plants are growing rapidly, one application a week is generally sufficient, but if growth is rapid and the beetles are abundant two or more applications may be necessary, especially if rains occur frequently. Applications should be made when showers remove the dusts. Ten or twelve applications are generally sufficient for a season, but more may be necessary when an unusual number of showers occur. The dusts should be used at the rate of 20 to 70 pounds per acre according to the size of the vines.